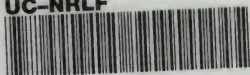
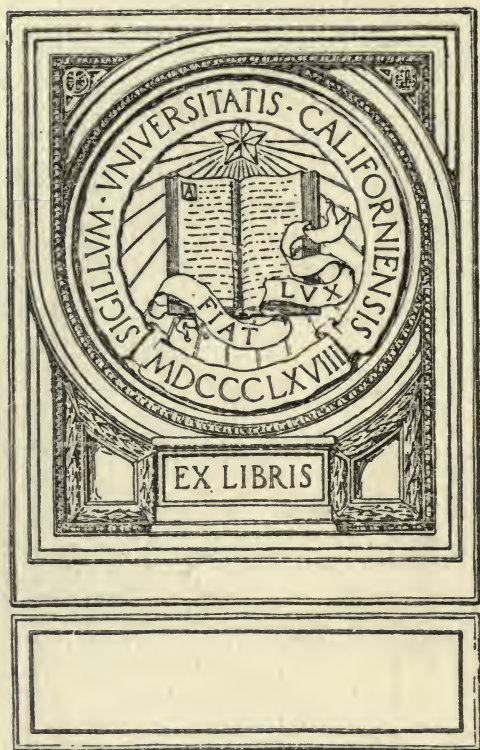


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Opportunities for Handicapped Men
in the Brush Industry

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Bureau of Vocational Guidance
Division of Education
Harvard University

Prepared by the
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In cooperation with
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Disabled Men, New York



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in the Brush Industry

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The Brush Industry

Foreword

THIS report is the result of one of a series of investigations made by the Harvard Bureau of Vocational Guidance. It represents a survey of several representative plants made by the author and others who visited the manufacturing departments and studied all of the processes involved. The material presented is intended to be helpful to vocational counselors and placement agents as well as to crippled men who wish to inform themselves regarding the occupational opportunities in industry.

The aim in this report has been to give a general idea of the processes involved in brushmaking. Unlike some industries, there is a great variety in detail of method in the making of brushes. Companies have developed special methods of their own for carrying on certain processes and, to some extent, desire to keep these methods for themselves. It has, therefore, been impracticable to suggest all the various phases of brushmaking. The effort has rather been to follow through the process logically, describing as nearly as possible characteristic operations. In attempting to place handicapped men, it will be found that the discussion in this report will give a sufficiently definite idea of the character of the work involved, though the details may be somewhat different in different communities.

As has been suggested in the Bureau's report on the rubber industry, it is impossible to say definitely that all men with certain handicaps can engage successfully in

all the operations suggested for those handicaps. The element of individual differences in men, and the sympathetic assistance which they may receive, naturally play a very important part in their future in any employment.

The making of certain unusual forms of brushes, such as those used in certain textile operations and patented wire brushes, has not been taken up in this report. Because the making of these brushes is comparatively limited and because a number of the operations are similar to those described in connection with the making of other brushes, it has not been deemed advisable to take added space for a separate discussion.

Opportunities for Handicapped Men in the Brush Industry

Brushes and Brushmaking. There is some doubt as to the origin of the word brush. Some authorities maintain that the word developed from the fact that primitive brushes were made from brush wood. It is more probable, however, that the word developed from the same root as the German word *borste*, which means bristle.

The use of brushes dates back to very early history. The brush or broom is mentioned in Homer. In later history the brush appeared in the broom of the housewife and of the chimney sweep. In modern times the brush has developed in a great variety of forms to fit particular needs.

Before the opening of the nineteenth century, England supplied most of the brushes used in this country. During the War of 1812 domestic brushes began to supersede those which had previously been imported. One of the earliest brush factories in this country, of which we have record, was established in Massachusetts. The lead which Massachusetts obtained by entering the field in the early history of the industry is still maintained, although New York state is at present a close rival. Other states manufacturing brushes to an important extent are Maryland, New Jersey, Ohio, Illinois, and Pennsylvania.

The Development of Brush Factories in the United States. Like all other industries of early origin the making of brushes was confined to hand operations. Small establishments grew up here and there in the United States. Some of the work was done in the shop and some was taken home to be done by housewives and children during

leisure time. The custom of sending work into the homes has largely disappeared in the United States at the present time, partly as a result of labor legislation and partly because it has shown itself to be non-economic. The tendency for the work to be done in small factories is, however, still very evident. The Table below showing the average number of wage earners per establishment in the United States from 1849 to 1914 demonstrates how the small plant has remained in the field. In the 65 years between these dates there has been an average increase of only four wage earners per establishment, and if we take the figures for 1859 there would be an average increase of only one wage earner per establishment. It is probable, however, that between 1914 and the present time there has been a further increase in the average wage earner per establishment.

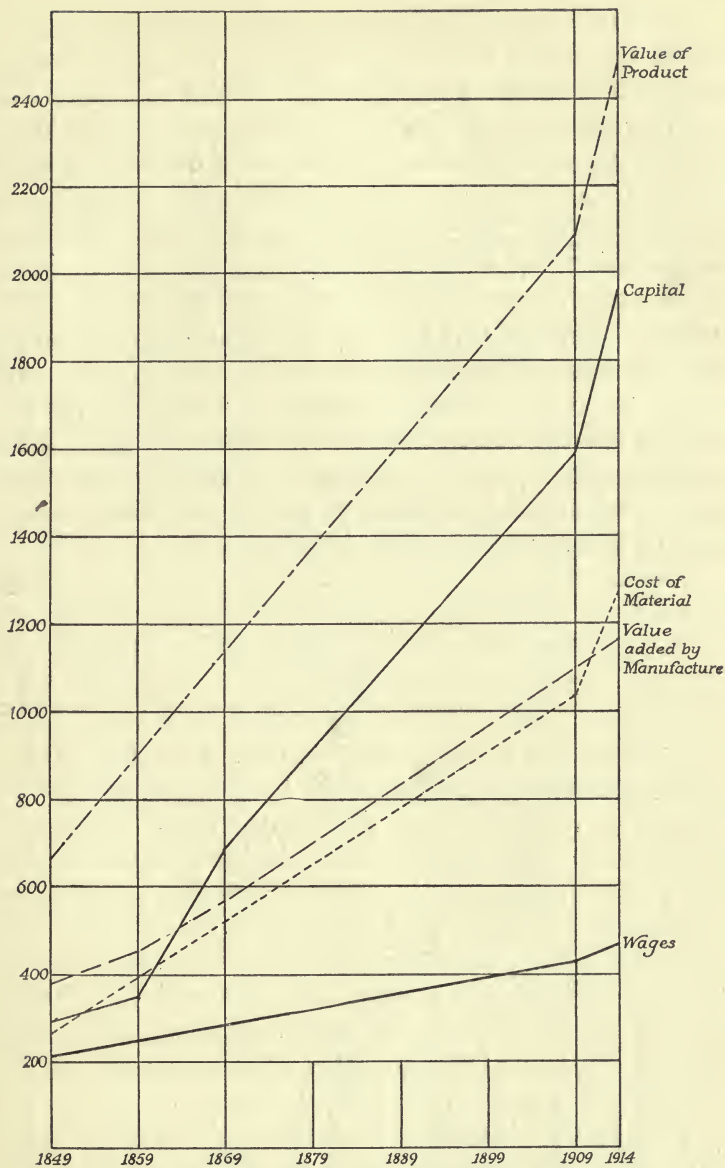
DEVELOPMENT OF THE BRUSH INDUSTRY IN THE UNITED STATES

Showing Increase in Dollars per Wage Earner

	Capital	Wages	Cost of Material	Value of Product	Value Added by Mfg.
1849	296	221	265	654	389
1859	342	249	418	881	463
1869	694	284	541	1111	570
1909	1595	437	1033	2113	1080
1914	1987	479	1293	2480	1187

Average Number of Wage Earners per Establishment

1849	16
1859	19
1869	16
1909	18
1914	20



Development of the Brush Industry Showing Increase in Dollars per Wage Earner

Development of Machine Methods. Although a great many operations in the brush industry are still carried on by hand, machinery has come to play an important part in the making of certain kinds of brushes. The Table on page 8 shows the increase in dollars per wage earner for certain costs involved in the brush industry. In this Table it will be noted that the capital invested per individual wage earner was only \$296 in 1849, while in 1914 it was \$1987, or an increase of more than 600 per cent per individual. Some of this increase is undoubtedly due to the development of factory buildings, but obviously this does not account for the entire increase. A considerable portion of it must be attributed to the introduction of labor-saving machinery and equipment. Machine methods are now used in such operations as sorting bristles for length, mixing bristles, and stapling bristles.

Wages. Turning again to the chart on page 8 it will be noted that there has been a marked increase in the average wage paid to workers in the brush industry, although this increase seems relatively small as compared with other industries. It must be borne in mind, however, that the period between 1914 and 1917 has seen a further increase in wages which undoubtedly will be the minimum for the future, so that the wages paid in the brush industry at the present time compare more favorably than in 1914 with the wages paid in other industries. The brush manufacturer in the past has been laboring under two handicaps: first, the difficulties involved in a great number of hand operations, where production must of necessity be relatively uniform; and, second, he has had to compete with conditions in other countries where labor is much cheaper than in the United States.

The Work and the Worker. There are a number of features about the industry which should make it attractive to the worker. Although the increase in wages has been

DEVELOPMENT OF THE BRUSH INDUSTRY IN THE
UNITED STATES

United States	Number of Establishments	Wage Earners (Average Number)	Capital	Wages	Cost of Materials	Value of Products	Value Added by Manufacture
			*	*	*	*	*
1914	359	7,213	14,333	3,461	9,327	17,894	8,567
1909	384	6,954	11,092	3,041	7,187	14,694	7,507
1869	157	2,425	1,684	691	1,313	2,695	1,382
1859	121	2,378	914	594	994	2,097	1,103
1849	146	2,405	711	533	638	1,574	936

* Expressed in \$1000

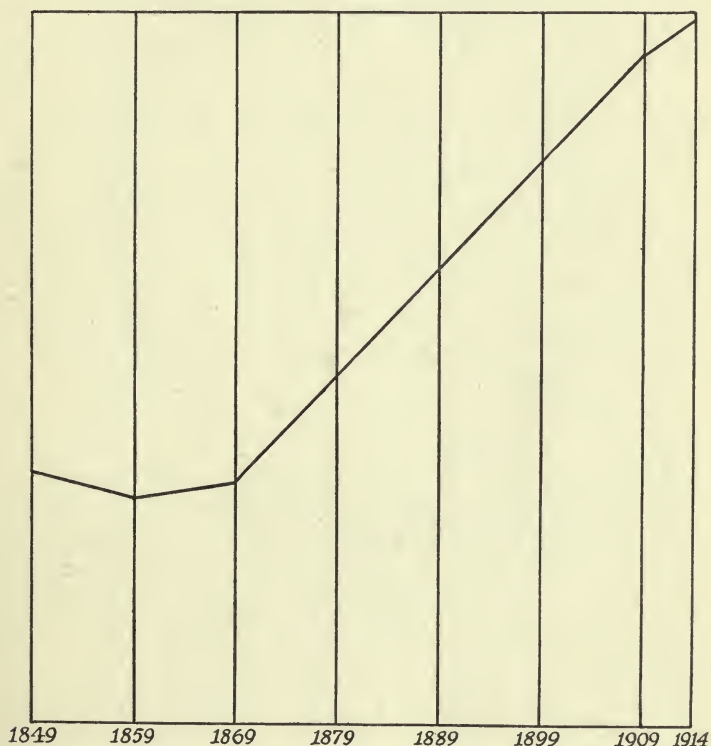


*Chart Showing Increase in Number of Persons Employed
in Brush Industry, 1849-1914*

relatively small up to 1914, there has been a consistent development. The Chart on page 11 shows that from 1849 to 1914 there has been a wholesome increase in the number of persons employed in the industry. A study of the Table on page 11 also indicates the promising growth of the industry from the standpoint of capital invested and products manufactured. The Table below shows the number of workers employed by months for the year 1914. It will be noticed how constant the employment was throughout the year.

NUMBER EMPLOYED BY MONTHS IN BRUSH INDUSTRY
IN UNITED STATES IN 1914

<i>Average for 1914</i>	7,213
January	7,446
February	7,441
March	7,440
April	7,339
May	7,222
June	7,102
July	7,114
August	7,043
September	7,082
October	7,298
November	7,066
December	6,963
Per cent Minimum is of Maximum . . .	93.5

DISTRIBUTION OF WAGE EARNERS IN BRUSHMAKING
INDUSTRY IN CHIEF BRUSH-PRODUCING STATES, 1914

	Average Number Employed	Sixteen Yrs. of Age and Over		Under Sixteen Yrs. of Age	
		Male	Female	Male	Female
Massachusetts	1398	730	655	3	10
New York	1683	1188	476	8	11
Maryland	572	438	75	43	16
New Jersey	853	548	287	6	12
Ohio	664	518	146	..	..
Illinois	348	233	102	8	5
Pennsylvania	376	315	53	7	1

RELATION OF MALE TO FEMALE EMPLOYEES IN SEVEN
LEADING BRUSHMAKING STATES, 1914

Male	68 per cent
Female	32 per cent

Although many of the brushmaking plants are housed in older buildings, conditions of work are generally pleasant. A large number of women are employed and these are usually of a fairly high type. Very little of the work, even in machine operations, involves any serious risks to the worker. A worker who has once learned to handle bristles seems to have no difficulty in finding employment. In fact, a great number of these people have been retained in the employment of the same company for a long term of years.

The Brush Industry in the United States. A great variety of brushes is made in the United States at the present time. Among these are paint brushes of all sorts and various kinds of toilet brushes, tooth brushes, and cleaning brushes. In 1914 the total value of manufactured brushes was \$17,894,000. Only \$449,909 worth of these brushes were sent abroad that year, so that it will be seen that most of the brushes were produced for domestic use and that only in certain restricted lines were we able to compete with non-American brushmakers.

The effect of the war upon the brush industry has tended to give an impetus to manufacture in the United States. The European countries which have been constant competitors have either been unable to export to this country or have been unable to manufacture on the scale which they had reached prior to the war. In 1914 our imports from Europe were \$1,500,000; in 1917 they had fallen to \$400,000, making a difference of \$1,100,000, a portion of which, at least, fell to the local industries. In 1914 we exported to Europe brushes valued at \$449,909.

In 1917 we exported brushes to the value of \$863,630, an increase in exports of \$413,721. On the other hand, our imports from Japan increased 170 per cent during this period, so that while in 1914 we were importing brushes to the value of \$665,952, in 1917 our imports had reached \$1,800,300. This made an increase of imports from Japan of \$1,034,348, or an amount greater than the falling-off of imports from Europe. On the other hand, by taking into account the increase in our exports to Europe, we see that there was an important actual increase in the manufacture of American brushes.

Up to the present time, the American manufacturer has been able to compete in the toilet brush industry only in certain lines. A great number of these brushes have come from France, Japan, Germany, England, and Austria. The best qualities have come from France and England. The domestic manufacturers have been able to compete with foreign goods in the cheap and medium grades rather than in the more expensive toilet brushes. This is due to the fact that we are able to produce such brushes by machine processes, whereas in the more expensive brushes commonly made by hand, the United States is unable to compete with foreign labor.

Comparatively few manufacturers in this country have been able to compete with the imported tooth brushes. However, two or three firms at the present time are carrying on an excellent tooth brush business as the result of the introduction of machine methods. Although the American-made tooth brush cannot be produced to sell at as low a figure as imported brushes, it is of uniformly good quality, so that a reputation once established and connected with a trade name makes the domestic brush very acceptable to a large number of people who are attracted by reliability and a relatively moderate cost.

Brushes for applying paints, varnishes, etc., meet with very little foreign competition. Prior to the war, Germany was the only country that sent paint and varnish brushes to the United States. At the present time Japan is making efforts to sell paint and varnish brushes in this country, though little progress has been made. The popularity of the American-made paint and varnish brush in this country is due in part to the fact that it was able to establish a reputation for itself before the foreign manufacturers entered the market. There are also a number of other factors such as material, importation duties, etc., which have tended to make our brushes more popular.

The Future of the Brush Industry in the United States. It is to be hoped that the impetus which brushmaking has received in the past few years will not be lost. Although the small factory has a number of advantages, it has tended to retard the development of the machine methods. With the close of the war, labor conditions will tend to return to normal in Europe, but it is not likely that the scale of wages will be appreciably reduced. The tendency will, therefore, be for wages abroad to approach more nearly the wages paid in this country, so that to some degree we shall feel less keenly the competition of cheap labor in the brush industry. In order that domestic manufacturing shall continue to develop, the manufacturer should bear in mind three things:

1. Material saving in the cost of production can frequently be made by a study and careful re-arrangement of methods of handling material and by an analysis of operations which will tend to eliminate wasteful methods.

2. The introduction of a greater number of machine processes will tend to reduce the cost of production and at the same time will give an opportunity for an increase in wages.

3. There is a growing demand among Americans for a substantial product at a reasonable price. The manufacturer

can frequently educate his trade, through consistent advertising, to an appreciation of the ultimate value of his product, although the initial cost may be slightly greater than that of a less substantial substitute.

BRISTLES AND BRISTLE SUBSTITUTES

Bristles used in brushes come from hogs. Fine brushes, such as artists' brushes, are made from hair of fine texture, such as squirrel's. The so-called camel's hair brush is made from the hair of the Russian gray squirrel. There is some doubt as to the origin of the term camel's hair, but it seems probable that it was originally Campbell's hair.

The best hog bristles have come from Russia; in quality China has ranked second. France and Germany have also produced some bristles in the past. In this country we do not allow our hogs to get old enough to produce the strong texture which is necessary in a good bristle. The Russian bristle grows on hogs which are allowed to roam in a semi-wild state and which are exposed to the cold of winter. This develops a long bristle which is tough and will stand a great deal of wear. In the case of the Chinese bristles, which are of excellent quality, most of the hogs come from the inland regions where they must be much more hardy than our common barnyard variety of hog. At the present time some bristles are being imported from India. These are characterized by the length of the flag. The flag appears at the outer end of the bristle and is the breaking up of the individual bristle into a number of small ends. Prior to the war, German merchants controlled the bristle trade in Russia, and English and German merchants controlled the trade in China. Since the war, English capital has been playing a more important part in the Russian trade, though at the present time practically no bristles are being obtained from Russia.

The method of collecting bristles in Russia is interesting. A great many of the bristles come from rural districts which are a considerable distance from important towns. The farmers collect the bristles from their hogs as they are killed and store them in their homes until an itinerant peddler visits them. This peddler may make a business of buying only bristles or he may deal in other commodities. Usually he carries with him a stock of miscellaneous hardware and other household necessities which he exchanges for bristles. The bristles are taken to some trading center, such as Nizhni Novogorod. At this place fairs are held where the itinerant dealers sell their bristles to shippers or manufacturers. The bristles as they are brought in from the outlying districts are dirty. Some of them are thoroughly cleaned before shipping. Others are only roughly cleaned and are required to be put through a thorough cleaning process after reaching this country.

Besides bristles, a number of substitutes are used in making brushes of the cheaper grades. Horse hair is a common substitute; tampico and other fibers are used in the rougher sorts of brushes, such as floor brushes. Sometimes the substitutes are used alone, while at other times a layer of bristle is placed around the substitute.

Brushes. Brushes are generally classified as simple and compound. The simple brush, such as the ordinary paint brush, contains only one tuft of bristles. The compound brush, such as the tooth brush or hair brush, is made up of a number of tufts. Bristles are fastened into handles in the following ways:

1. Setting in cement or rubber. In this process the bristle is set in cement or rubber.

2. Wire drawn brushes. The bristles are fastened by a wire thread caught over the center of a knot of bristles, drawing it into a hole underneath. Commonly the wire is inserted from the back of the handle. In some cases, however, the

wire is drawn lengthwise through the middle of the handle so that it does not appear on the back at all and no covering is necessary. Brushes made in this way are said to be trepanned.

3. Pitch set. The bristles are dipped in pitch and inserted into the holes in the back of the brush.

4. Stapling. This process consists in fastening the knots in holes in the brush by driving a staple over them.

TREATMENT OF BRISTLES

Washing and Scrubbing. Most bristles, regardless of what cleaning they have gone through before reaching the manufacturer, are washed in the brush plant. The bristles are first allowed to soak in large vats. In some cases the cleansing is made more thorough by boiling the bristles. In this process the bristles are immersed in water and steam is turned into the water. White bristles are put through a scrubbing process. The bristles are immersed in soapy water and are scrubbed either by hand or by machine. In this process the worker rubs the bristles over a stone, thereby loosening any particles of dirt which have not previously been washed out. In the machine process, a combing device is drawn through the bristles, thereby rubbing them and mixing them thoroughly with soap. After being thoroughly scrubbed the bristles are rinsed. In many plants they are dried by being placed in drying rooms where a constant temperature is maintained for a number of hours.

Putting Bristles in Cones. Before bristles are boiled they are either put in a small metal flask called a cone, which tapers slightly towards the bottom, or else they are wrapped firmly with string. In putting the bristles into the cones the flag or smaller end is downward. This method of confining the bristles is employed to assist in straightening them.

When the bristles are removed from the drying chambers they are thoroughly dry and straight, and can be removed from the cones or bundles. In most instances, the work of putting the bristles into the cones, and of boiling, washing, and scrubbing is done in part, at least, by the same men. The tying of the bristles requires considerable experience, as is true of all operations where bristles are handled. Anyone not familiar with the brush industry is surprised at the difficulty involved in handling slippery, tapering bristles which tend constantly to slip about in one's hands. Experienced handlers of bristles have generally spent from three to five years in the industry. The work of tying bristles and putting them into cones is light except in factories where the worker is expected to handle boxes of bristles which weigh from 130 to 160 pounds. If provision could be made to bring the bristles to the worker he could remain seated most of the time, and consequently the loss of a leg would not be a serious handicap. Hernia or defective hearing would also not prevent him from doing this work. On the other hand, the worker must develop a delicate touch and skill in handling bristles, and any form of nervous disorder would be a serious drawback. As has been suggested, unless special training in handling bristles could be given the worker it would take him a number of years to gain proficiency. The wages vary from \$18 to \$20 a week. The other operations, previously described, would require an able-bodied worker. The wages are about the same.

In some cases the bristles are bleached after they are washed. This work is very similar to the washing process, as far as physical requirements are concerned.

Hand Combing. After the bristles are removed from the drying chambers they are usually combed out to break up the bundles and to eliminate any bristles which are not straight in the bundle. The work of combing is

commonly combined with some other operation such as mixing. The worker would be compelled to stand and ought to have the use of both hands, although it is possible that the loss of one or two fingers would not prevent him from engaging in this operation. Hernia or defective hearing would also not prove serious handicaps. The same training is required in this operation as is required for other operations where bristles must be handled. When this work is combined with another operation the salary usually varies from \$20 to \$30 a week.

Sorting Bristles for Texture. In the making of brushes, such as toilet brushes, where the bristles must be of a uniform thickness, it is necessary to sort them. This is commonly done by putting the bristles in a boxlike tray about eighteen inches long and half as wide. The tray is divided into a number of square compartments, each one of which holds bristles which are put in with their thin or flag end down. The bottom of the tray, instead of being solid, is made of a small mesh wire. After the bristles have been put into the case, the operator shakes and pounds it on the table. This forces the bristles of small diameter part way through the mesh. After the operation of shaking is completed the worker draws out all the bristles which have come through the mesh. These will naturally be of fine texture. This work requires considerable activity on the part of the worker so that with the exception of the loss of two or three fingers, hernia, or defective hearing, he should be able-bodied. Inasmuch as he must handle the bristles, his training should be the same as that previously mentioned. Wages range from \$15 to \$20 a week.

Dragging Bristles. Dragging is the process by which bristles are sorted according to their lengths. The work is done either by hand or by machine. In the case of hand dragging the operator takes a bunch of bristles in one

hand with the butt or thicker ends arranged evenly. This allows the flag or thinner ends to protrude according to their varying lengths. The operator then takes a small knife and by drawing it through the bristles at varying heights selects them according to their lengths. The bristles are arranged in piles varying by a quarter of an inch. In the case of machine dragging the bristles are laid out on a narrow shelf three or four feet long, with their butt ends arranged flush against the back of the shelf. This, as in the case of hand dragging, allows the various lengths to protrude. When the machine is set in motion a clamp arrangement opens and closes on the bristles, picking out first the longest ones. The same mechanism passes the bristles to the rear of the machine and drops them into pans. At each operation the clamp device moves a quarter of an inch nearer the bristles so that they are picked out in lengths varying by a quarter of an inch. In both hand and machine dragging the operator must have had experience in handling bristles. He should be able-bodied, with the exception of possible loss of two or three fingers, hernia, or defective hearing. In the case of hand dragging, the loss of one or both legs would not be a serious handicap, providing arrangements could be made for carrying work to and from the operator. Wages are about \$20 a week.

Cutting Bristles. In the making of toilet and similar brushes it is desirable to have the bristles of uniform length. This involves the trimming of the bristle ends. This work is usually done in a bench shears between two blades built so as to form a V-shaped opening into which the bristles are placed. The shears are operated by hand. This work is usually combined with some other operation, such as sorting for texture. The cutting operation itself requires a man with moderate physical strength in his arms. In most factories it would be necessary for him to

move around the shop more or less. The loss of one or two fingers would not prove a serious handicap, although the worker would have to be able to handle bristles with facility. Heart trouble, hernia, or defective hearing would not prevent one from doing this work. This operation is usually combined with other work so that the man receives a salary of from \$20 to \$30 a week. His training would be similar to that required in other bristle-handling operations.

Mixing Bristles. Various methods are used for mixing bristles where it is desired to unite different qualities or textures in the same brush. Bristles for tooth and hand brushes are commonly mixed by scattering them in layers over a table. These bristles are thoroughly stirred and mixed by hand. This work naturally requires the constant use of the hands, and the worker must be able to stand and move about, so that with the exception of loss of fingers, hernia, heart trouble, certain nervous disorders, or defective hearing he should be able-bodied. The work of mixing or 'shaking up' does not require a great amount of experience, and it is common to put beginners in the bristle department at this work. Two or three days' experience would be sufficient to fit one for this work. The wages are about \$20 a week. In mixing bristles, particularly for paint brushes, a mechanical method is frequently used. After the bristles have gone through the hand-combing process they are placed in the mixing machine. By passing over a series of endless belts they are thoroughly mixed. While this operation of mixing is being carried on the bristles are combed. This is done by carrying them on a belt to which they are firmly held by means of a chain following the belt. The belt passes them through a revolving comb device which draws out the bristles which have become crossed or bent. This machine throws out a considerable amount of bristles which must

be reclaimed. The machine method of mixing and combing is, therefore, more wasteful of material than the hand method, but on the other hand it does considerably more work in the same time. Each mixing machine is in charge of an operator who must be active both with his hands and with his legs. The loss of one or two fingers would probably not interfere with this work. In other respects the worker should be able-bodied. His training is the same as that for other workers in bristles. The wages vary from \$25 to \$30 a week on a piece basis.

Bunching Bristles. After the bristles have gone through the processes previously described they are usually tied in knots. This is particularly necessary when the bristles are used in some mechanical process of brush-making. The work of bunching is done at tables by workers who are seated. In most cases women do the bunching. The physical disabilities are the same as for other sitting operations where the use of the hands is particularly important. A fair amount of experience in handling bristles is a prerequisite in this work. The wages of women workers are \$12 or \$13 a week.

Trimming Bristles in Bunches. Where it is desirable to have the bristles of exactly the same length the ends are clipped off after they have been bunched. This work is done with a clipper similar to that used in barber shops. The clipper is stationary and operated by power. Usually the trimming of the bristles does not offer enough work to keep one person busy all the time. The physical disabilities would be the same as for other operations where the worker is required to move about for a portion of the time. The wage would probably be determined by the other operation in which the worker was engaged.

Reclaiming Bristles. Where a considerable amount of bristles is thrown out in the process of handling, some method of reclaiming these bristles is generally used.

Reclaiming consists of two primary operations: first, the combing and straightening of the bristles, and second, the arrangement of the bristles with the flag ends together. The work of combing is very similar to the work of the hand-combing operation previously described. Two methods of arranging the flag and butt ends of the bristles will be suggested. In the first method the bristles are drawn over a fine mesh comb. This comb catches the butt of the bristles only. Since the flag end is smaller and does not stick in the mesh it is then a simple matter to pick the bristles out with their butt and flag ends together. This operation is repeated until all the bristles have been sorted. The second method depends for its operation on the fact that bristles taper from their butt ends to their flag ends. By arranging them in a long row across a table and working the hand or a board across them at right angles, the bristles with their butt ends outward will work away from the hand or board. These are picked up from time to time during the process until all the butts have been placed together. The work of reclaiming requires standing and moving about, so that the operator should be able-bodied with the possible exception of the loss of one or two fingers or defective hearing. As in the case of other operations where bristles are handled the worker requires considerable experience. Wages vary from \$25 to \$30 a week.

WIRE DRAWN BRUSHES

Drilling Holes in Backs. The process of making trepanned brushes will not be described in detail as it is not common in this country. It is, however, a phase of the wire-drawn method for making brushes. The backs of wire-drawn brushes must be drilled in such a way that a shoulder will be formed in the hole against which the knot

of bristles will be drawn securely by the wire which comes through from the opposite side. The work of drilling is done with a small power drill, operating in a horizontal rather than a vertical plane. The worker has a tool rest on which he holds the back of the brush. His drill is so arranged that it bores a hole which is large enough to receive the knot of bristles on one side, but only large enough for the insertion of the wire on the other. The work of drilling must be done rapidly, as in many brushes there are a great number of knots of bristles. Facility in this work can be obtained only through experience. The operator should be able-bodied with the exception of the loss of one or two fingers on one hand or the loss of a leg below the knee, defective hearing, or hernia. The wages are about \$25 a week.

Drawing Bristles. The work of drawing bristles is usually done by women. It is an uneconomical operation, as it involves a maximum of labor with a minimum of production. The worker is seated throughout the day at a small table. The bristles are placed conveniently on the table and the worker selects from the pile the required amount to make each knot. The knot is placed through the loop in the wire which has been drawn through the hole in the back, and then the wire is drawn firmly into the hole. This fastens the bristles securely and the wire is threaded through the next hole. Loss of legs would not be a serious handicap in this work. The worker, however, should have the use of all of his fingers. Hernia, heart trouble, defective hearing, or stiffness of trunk muscles would not prove serious handicaps. It is possible with special training and with special arrangements of the working table that an operator partially or totally blind could learn this work, though it is probable that he would have to confine himself to the making of certain types of

brushes, as the pattern to be followed in lacing through the holes varies in different types of brushes.

Window and some styles of toilet brushes are commonly made by the hand-drawn method. The wire at the back of the brush is covered by a thin strip screwed or fastened in some similar method over the holes. The worker must have experience in handling bristles and his fingers must be trained to select a uniform quantity of bristles for each knot, as too few would make a thin knot and too many would make it impossible to draw the knot into the hole and would add to the cost of the brush. The wages for women workers are \$12 to \$15 a week.

HAND-SET BRUSHES

Drilling Holes. The backs of the hand-set brushes are drilled in a manner similar to that employed in drilling backs of wire-drawn brushes except that the hole is not carried entirely through the back.

Tying, Dipping, and Setting. These three operations are done by a single worker. The equipment is practically the same as that for wire-drawn work except that no wire is used. The worker selects a knot of bristles, dips one end in pitch, ties a thread around one end, again dips the end in pitch, and inserts it without doubling into the hole which has been drilled in the back or handle. This operation is repeated until the holes are all filled. The physical requirements and experience are the same as in the case of wire-drawn brushes, though it would probably be more difficult for the worker to get along without relatively good eyesight. The wages are the same as in the case of wire-drawn work.

Brushes which are set in pitch are usually of the cheaper variety and are not expected to be used in hot water or in chemicals which would affect the pitch.

STAPLED BRUSHES

Drilling. Staple brushes are drilled in a manner very similar to the set brushes. Care must be taken to leave sufficient wood to receive the staple.

Stapling. Stapling is usually done by machinery. The staples enter the machine in the form of wire. By a mechanical arrangement the staple is bent over the center of a knot of bristles and they are forced into the hole in the back or handle of the brush. A particular phase of this work will be described in a latter portion of this report in connection with the making of tooth brushes. The operator of the stapling machine should be able-bodied with the exception of loss of two or three fingers, hernia, or defective hearing. The wages are about \$20 a week. The stapling process is growing in popularity because it can be done mechanically. A variety of brushes are at present stapled. Among these are handbrushes, scrub-brushes, and tooth brushes.

TYPES OF SIMPLE BRUSHES

General Discussion. As has been suggested in the early part of this report, brushes are divided into simple and compound brushes. Those which have already been described have been of the compound variety. There are a great number of brushes containing a single tuft of bristles. In practically all of these brushes the bristles are held together or are held to the handle by some form of cement. In the case of the more durable brushes the bristles are set in rubber. These brushes can be divided roughly into the following classes: (1) stucco brushes, (2) flat wall brushes, (3) round and oval brushes, (4) kalcimine and whitewash brushes, (5) flat varnish brushes, (6) sash and artists' brushes, (7) lather brushes. These brushes vary in shape, quality of material, and method of manufacture.

STUCCO BRUSHES

Knot-Making. In a great many stucco brushes pure bristles are not used. The center is sometimes formed of a mixture of horsehair and bristles. The work of making the brush is done at a small table, usually by women. They select the proper amount of horse hair and bristle. By laying out the bristles over the horsehair and cleverly folding the knot, the bristles are made to completely surround the horse hair. Care must also be used so that the bend of the bristle is towards the center of the brush. The flag ends of the bristles are always placed outward in all brushes. After the knot has been formed, a plug is inserted in the center of the butt end of the knot and a false ferrule is fitted over the bristles. This work can be done seated so that loss of legs would not prove a serious handicap. Heart trouble, hernia, or defective hearing would also not prevent one from doing this work. On the other hand, the worker should have complete control of his hands and fingers, for skill of manipulation is required, as in the case of other bristle-handling operations. Without special training the worker requires a number of years' experience before becoming familiar with this form of brushmaking. The wages are from \$16 to \$18 a week.

Cementing Bristles. With the exception of rubber cement, bristles are cemented in the same general way. The object in cementing is to see that the cement thoroughly permeates the knot. In some cases the ends of the knots are allowed to stand in cement for a considerable length of time. In the case of smaller brushes the ferrule is placed on the brush before the cement is applied. In this form of cementing the cement is forced into the bristles by means of compressed air. Stucco brushes are usually treated in the former manner. The larger brushes are usually cemented by men. The worker should be able-bodied with the ex-

ception of loss of two or three fingers or defective hearing. Two or three months' experience is necessary. Wages range from \$14 to \$18 a week for men. In the case of the smaller brushes girls do the cementing. A good deal of this work could be done seated, so that the loss of a leg below the knee would not be a serious handicap. The other handicaps are the same as in the case of the men operators. Girls receive from \$12 to \$14 a week.

FLAT WALL AND VARNISH BRUSHES

Gumming Bristles. After the brush has been formed it is frequently desirable to treat it so that the bristles will not be disturbed until it has passed through the different processes of making. In order to hold the bristles in their original form they are dipped in a solution of flaxseed, which, when it is dry, holds the bristles together. The gumming is done chiefly in the case of brushes which are to be vulcanized in rubber. The work of gumming is done by girls who are seated. The operation consists of dipping the brush in a pan of flaxseed solution. Although the operation appears simple at first sight, the worker must be careful that the bristles are correctly shaped in the brush, for otherwise the form of the brush would be spoiled. The loss of one or both legs, two or three fingers, hernia, heart trouble, or defective hearing would not prove serious handicaps. It seems possible also that with training a worker with partial or total loss of sight could learn to do this work. The wages are about \$12 a week.

Making Flat Wall Brushes. Flat wall brushes are made in the same general manner as stucco brushes, except that a metal ferrule instead of a leather binding is generally used. Instead of inserting a plug the brush is sometimes made solid. The operations involved in making the brush are so similar to those involved in making stucco brushes that no further description will be offered.

Making Flat Varnish Brushes. Both the flat wall and flat varnish brushes are set in either cement or rubber. Flat varnish brushes are commonly smaller than the wall brushes. They are usually fitted with a tin ferrule which is nailed to the handle. The work in making the flat varnish brushes is very similar to that described for other brushmaking processes.

ROUND AND OVAL PAINT AND VARNISH BRUSHES

The bristles for round and oval paint and varnish brushes are made into knots in a manner similar to other knot-making operations, and require the same experience.

Fitting Ferrules to Oval and Round Brushes. A number of methods are used for putting the ferrules over the knots. In some cases the bristles are treated with a small amount of cement. The ferrule is placed over the butt end of the knot, and the pointed handle commonly used in this variety of brush is driven through from the opposite end. This furnishes the brush with a plug, and at the same time forces the bristles firmly against the ferrule. The ferrule used in making these brushes is shaped like an inverted cup with a hole left in the bottom to permit the handle to pass through. The worker must be able-bodied, with the possible exception of loss of fingers or defective hearing. The driving of the handle into place is done with a small sledge, so that a fair amount of strength is required. On a piece basis the wages range from \$20 to \$25 a week. Three or four months' experience is necessary before the worker has acquired a sufficient degree of efficiency.

Making Brushes with Chiseled Ends. An examination of the better grades of varnish brushes will show that the ends taper slightly. This taper is put in to insure a regular and even flow of paint. It is also highly desirable that the

flag ends shall not be clipped in order to obtain this taper, as the flag of the bristle assists in holding and distributing the paint. As a matter of fact, in some cheaper grades of brushes the end of the brush is made even and the taper is put in by clipping the bristles. In the round and oval brushes it is particularly important that the taper be made, as the brushes are unusually thick. Two of the most characteristic methods for obtaining this taper will be described. In the first method, a knot of bristles is placed in a metal cup the size and shape of the brush. The bottom of this cup is slightly concave, so that the bristles take on the shape of the bevel. The bristles are tied in this form prior to cementing and placing in ferrules. Most of the ferrules for oval and round brushes are made of iron rather than tin. In another method for obtaining the bevel the bristles are tied in knots with their butt ends even; the worker depresses the center of the butt end of the knot, thus forcing the center of the brush outward and making the bevel at the flag end. In both methods for beveling brushes the worker may remain seated for the entire work, so that loss of one or both legs would not prove a serious handicap providing the work was brought to the bench. Loss of one or two fingers, hernia, heart trouble, or defective hearing would also not prevent him from engaging in this work. The worker should have the experience or training suggested in other operations where bristles are to be handled. The wages vary from \$20 to \$25 a week.

Putting Handles on Oval and Round Brushes. One method of fastening handles to round and oval brushes has already been described. The other most common method is one which slightly decreases the outside dimensions of the ferrule with pressure at its two ends, thus clamping it over the knot and the handle at the same time. In some cases this is done with a screw

press operated by hand. In other cases the pressure is obtained in a machine press fitted with dies of the desired dimensions. Where the press is used the worker must be able-bodied in all respects, with the possible exception of the loss of one or two fingers or defective hearing. One or two months' experience would be necessary. Wages range from \$20 to \$25 a week.

The operator of the machine press may do most of his work seated providing the material is taken to and from his machine. Loss of two or three fingers or defective hearing would not prove a serious handicap, and it is probable that the loss of one leg below the knee would not prevent one from acquiring a moderate degree of efficiency in the operating of the machine press. The wages are about the same as in the case of the hand press.

SASH, ARTISTS', AND LATHER BRUSHES

Making Small Brushes. In the case of sash and artists' brushes, hair is frequently used instead of bristles. The work is similar to the making of other brushes, and it involves the same handicaps and training and wages. As in the case of making the other brushes, women are chiefly employed. The handles are fastened to the knot with small ferrules. This work is also bench work, and may or may not be combined with the operation of making knots.

Making Lather Brushes. Lather brushes are made of hair and bristles. The more expensive ones are made of badger hair. A great many lather brushes are at the present time being set in rubber in order to give them greater durability. The making of the knots for the brushes is similar to other knot-making processes.

Setting Bristles in Rubber. The process of setting bristles in rubber will be described for lather brushes. A similar method is employed in the case of other round and flat brushes. After the bristles have been tied in knots,

they are allowed to stand in a perforated tray with the butt ends downward. Rubber cement is then allowed to flow through the perforations of the tray until three-eighths or half an inch of the bristles is immersed. The bristles remain in this cement for various lengths of time, according to the size of the brush and the type of bristle or hair used. After the cement has thoroughly permeated the knot, the bristles are removed to a warm room where they remain over night, allowing the solvent in the rubber cement to evaporate. The ferrules are then fitted to the knot after the cement has been slightly softened on a warm plate.

In some cases, instead of dipping the bristles, ferrules are placed over the knots, and the right amount of rubber cement is poured into the ferrule. The brushes are arranged in racks with the flag ends of the bristles downward, so that the cement gradually soaks into the knot. In both the dipping and pouring processes a final vulcanizing takes place before the brush is ready to leave this department. In the dipping method the worker should be able-bodied with the exception of the loss of two or three fingers. The work involves the handling of sheets of rubber stock. These sheets are cut into strips and placed in large cylindrical mixers along with the necessary solvents. The worker must also handle the trays of brushes, so that there is a considerable amount of heavy lifting and moving about. Where the rubber cement is poured, women do the work. In most cases the work involves a considerable amount of moving about and stooping, so that loss of legs would be a serious handicap. Loss of two or three fingers or the loss of a hand or arm, hernia, or defective hearing would not prove serious handicaps, providing the worker could be relieved of all lifting, and providing he could acquire a fair amount of dexterity with his good arm. The dipping process requires

two or three months' experience, though the work of pouring the cement could be learned in a very short time. Men in the dipping room receive from \$18 to \$25. The wages for the women who do the pouring are from \$12 to \$15 a week. These women also put the ferrules on the brushes in most cases.

MAKING FERRULES AND FINISHING HANDLES

Cutting Tin. Up to this point the discussion has dealt with the general process of making brushes. There are a number of operations, however, which are usually carried on in brush factories through which the brush must pass before it is completed. In most of the smaller types of brushes tin ferrules are used. The tin for the ferrules is received at the factory in sheets or rolls. It is first cut into proper dimensions on a shear press. This work is usually done seated, though in some cases the operator is expected to supply himself with material. Besides cutting the tin for ferrules a design is often stamped in the ferrule blank. Providing material could be taken to and from the worker, loss of one leg below the knee, loss of two or three fingers, or defective hearing would not prove serious handicaps. The work could be learned in a comparatively short time. It is done by either men or women. The wages vary from \$12 to \$18 a week.

Bending Ferrules. After the tin has been cut to the desired size, it is bent in a press machine into the ferrule. The work is comparatively light and is done on a piece basis. The operator could remain seated for the entire day provided his material was brought to and from the machine. The loss of one leg below the knee would not prove a serious handicap where the machine is controlled by a foot-treadle. Loss of two or three fingers, hernia, or defective hearing would also not prove serious handicaps.

The work does not involve a lengthy period of training. Wages are about \$12 a week.

Soldering Ferrules. After the ferrule has been bent into shape, the ends are soldered. The worker may be seated or may stand, as he sees fit, so that the loss of a leg would not prove a serious handicap. However, in most cases he is expected to handle the case of ferrules. If other arrangements could be made for this work he would not have to move about the room at all. As each ferrule must be handled individually, rapid use of the hands is necessary. Beside the disability suggested, the worker would not be seriously handicapped by the loss of two or three fingers or defective hearing. Slight fumes are given off in the soldering process, although they do not seem to be sufficient to make the work unhealthful. Several months' experience would be required to learn the work and reach a maximum of speed. Wages are about \$25 a week on a piece basis.

Stamping Holes. In the case of some ferrules, where nails are driven through the cement of the brush, it is necessary to stamp the holes. This work is comparatively light, and is done on a press machine, usually by women. Loss of a leg below the knee, loss of one or two fingers, hernia, or defective hearing would not prove serious handicaps. A month's experience would be sufficient to gain moderate familiarity with the work. Wages are from \$12 to \$15 a week.

Tumbling. After the ferrules have been shaped and soldered they are put through the tumbling machine. This consists of a long revolving cylinder into which are placed the ferrules together with sawdust. The contact of the ferrules with the sawdust removes all acid or grease remaining on the tin. The operation of this machine requires no skill. The worker, however, must be active, with the exception of the loss of two or three fingers or

defective hearing he should be able-bodied. Two or three weeks' experience would offer sufficient training. The wages are from \$15 to \$20 a week.

Nailing Ferrules to Handles. In most instances paint brush handles are made outside of the brush factory, and in some cases they are painted outside the factory. Most brushes with tin ferrules have the ferrule nailed to the handle. In cases where a plug is used the nail goes through that portion of the handle. The work of nailing is done on an automatic machine which collects the nails from a drum, so that they hang point downward from a small chain conveyor. In this way they are carried to a position directly under a small vertical rod. When this rod descends it drives the nail through the ferrule into the handle of the brush. The operator places the brush in a clamp under the driving device, and the machine drives and spaces the nails automatically. This work is usually done by women who may remain seated throughout the day. Providing material is brought to the machine and taken away by some one else, the operator would not be seriously handicapped with the loss of one or both legs. Loss of two or three fingers, hernia, or defective hearing would not prevent one from working at one of these machines. It is also possible that with the assistance of a special appliance this work could be done with the loss of hand or forearm. Wages are from \$12 to \$15 a week on a piece basis. In a few cases nails are driven by hand, although this is not common.

Trimming Ends of Nails. Where the nails are driven through the opposite side of the ferrule the ends must be cut and turned. This work is usually done on a machine operated by hand, which first trims off the end of the nail and then turns it over. The work is done by forcing a bar, operated by a hand lever, across the nails, thus turning them down after they have been trimmed off. No

skill is required in this operation though considerable speed is necessary in order to make the day's wages. The work is usually done by boys or women. Loss of fingers, hernia, or defective hearing would not prove serious handicaps. Providing arrangements could be made for placing and removing work this operation could be carried on by a partially or totally blind person if he had had proper training. Wages are about \$12 a week.

Fitting Handles to Small Brushes. In the case of small, cheap brushes, handles are not carefully fitted into the ferrules. When the handle does not fit the ferrule exactly, the worker grinds it on an emery wheel. This tends to make a loose-fitting handle, as there is no force used in attaching it. This work requires rapid use of the hands, though the worker can remain seated throughout the day providing his work is brought to him. Loss of one or both legs, loss of two or three fingers, hernia, or defective hearing would not prove serious handicaps. The work is not skilled, so that it could be learned in three or four weeks. The wages vary from \$15 to \$20 on a piece basis, both men and women being employed.

Cleaning Brushes. Paint and varnish brushes are usually cleaned before they are sent from the factory. The cleaning is commonly done by a device which stirs the bristles, and at the same time draws off the dust by a suction arrangement. In a common form of cleaning machine the operator sets the brushes around the edge of a revolving wheel, the bristle ends out. This wheel is partially enclosed in the hood of the suction pipe. While the wheel is being revolved the operator runs a hand brush through the bristles. He must be active with both feet and hands, and with the exception of loss of two or three fingers should be able-bodied. His work does not take any degree of skill and can be learned in two or three weeks. Wages are about \$19 a week.

Buffing Ferrules. Before the brushes are wrapped the ferrules are run over a buffing-wheel which polishes the tin, giving it a pleasing surface. This work could be done seated provided material is brought to the operator, so that loss of one or both legs would not prove to be a serious handicap. Loss of two or three fingers, hernia, or defective hearing would also not prevent one from doing this work. Wages are about \$15 a week.

Stamping Brush Handles. Most paint brushes and varnish brushes are stamped with the trade name upon the handle before being wrapped for shipment. The brushes are commonly laid out in a row on the table. After the table has been filled, girls pass along with a metal die which stamps the impression by being struck a firm blow with a hammer. The use of both hands and legs is necessary in this work. Loss of two or three fingers, hernia, heart trouble, or certain nervous disorders, or defective hearing would not prove serious handicaps. At least one of the girls engaged in the work must be thoroughly familiar with the dies, where a variety of trade names are used. Other girls, however, could learn the work in two or three weeks. Wages vary from \$14 to \$16 a week.

Dipping Brush Handles. Where brush handles are painted in the factory, the work is usually done by dipping. This operation will be described in more detail under a later heading. In the case of paint and varnish brushes much of the dipping is done by hand, so that each brush is handled individually. Most of the work is done by women. The loss of fingers or defective hearing would not prove to be a serious handicap. Wages are \$12 or \$13 a week.

Wrapping Brushes. Paint and varnish brushes are usually put in individual wrappers before they are shipped. This work is done by girls and involves no skill

except that which could be acquired by one or two months' experience. By making a slight readjustment of methods in common use the work could be done seated. Loss of one or two fingers, hernia, heart trouble, or defective hearing would not prevent one from doing this work. With special training a totally blind person could reach a fair degree of efficiency. The wages vary from \$12 to \$15 a week.

MANUFACTURE OF TOILET BRUSHES

In the case of special operations involved in the making of toilet brushes it is desirable to discuss certain processes under a separate heading. The process of treating bristles in general is the same as that already described. Unlike the paint and varnish brushes, the handles for toilet brushes are commonly made in the brush factory.

Cutting Stock for Backs of Toilet Brushes. Various sorts of wood, such as maple, oak, walnut, and ebony are used in making these backs. The wood usually reaches the factory as lumber and must be cut into the desired lengths and widths. The cutting is done by circular saws, similar to those to be found in any mill. The work involves a fair degree of skill and care in manipulation in order to obtain speed of production combined with safety. It is possible that where partially cut stock is handled the worker could have an artificial leg below the knee. With the exception of this handicap or hernia he should, however, be thoroughly able-bodied. Two or three months' experience at least is necessary. Wages are about \$15 a week.

Planing Stock. After the stock is cut to size in two dimensions, it is run through a planer to obtain the desired thickness. The planer consists of revolving knife-blades into which the stock is fed by the operator. Both surfaces are trimmed at one time. Providing there is enough work to occupy the entire time of one man and providing he

would not have to carry his material to and from the planer, a worker with an artificial leg below the knee could operate this machine. The loss of one or two fingers, hernia, or defective hearing would also not be serious handicaps. The wages are about \$15 a week.

Shaping Brush Backs. Brush backs are not rectangular but have to have their corners rounded, and, in some cases, their top is concave or convex. After the backs have passed through the saws and planer, they are taken to the shaper. In this machine a series of small knives is arranged on a vertical spindle which passes through the worker's table to a height of two or three inches. This spindle revolves at a considerable speed. The block, which is to be shaped, is fastened to a pattern by means of short pins protruding from the pattern. The worker holds the block against the revolving blades until the block is the same shape as the pattern. One worker may have more than one shaping tool, according to the number of operations he is expected to perform. Each shaping tool adds some element of design to the finished back. In this work the operator usually is expected to stand, though with the exception of keeping himself supplied with stock, he does not have much moving around to do. An artificial leg below the knee would not be a serious handicap. Loss of one or two fingers, hernia, or defective hearing would also not prevent him from doing this work. On the other hand, he must be able to acquire a marked speed in the use of his hands in moving the blocks dexterously around the cutting edges of the spindle. He should, above all things, have a well-balanced nervous system, as a mismove on his part might lead to the loss of fingers. Work is usually done on a piece basis, and pays from \$20 to \$25 a week.

Sanding. After the brush backs have been cut into shape they are sanded by being held against revolving rolls covered with sandpaper. In this way the operator

can reach the concave surfaces without difficulty and can finish the operation of shaping. The work is usually done seated so that the loss of one or both legs below the knee would not be a serious handicap. The worker must, however, have full use of his hands, as rapidity of motion is essential. The loss of one or two fingers, hernia, or defective hearing would not prove serious handicaps. One or two months' experience, at least, is necessary, and it seems probable that a man should have a natural aptitude for this sort of work. The wages vary from \$12 to \$20 a week.

Cutting Cavities in Brushes. Where the bristles are set in some form of block which is fastened to the back of the brush, it is necessary to cut a depression in the back so that the block will fit into it. The back is fitted into a form which has an opening the same shape and size as that desired for the cavity. The cutting tool is similar to that used in shaping. The cutting tools are usually used in series, each tool performing a certain part of the operation. If arrangements could be made for the operator to have his work brought to him, the loss of a leg below the knee would not be a serious handicap. With the exception of the loss of one or two fingers or defective hearing, no other disability would be possible in this work. The operator in the case of shaping must work rapidly and accurately, and he must be able to set up his own machine. Three or four months' experience would be necessary to gain full familiarity with the work. Wages are from \$12 to \$18 a week.

Painting Brush Backs and Handles. Two methods of painting brush backs and handles are common. The dipping method, which has been mentioned, is the more popular at the present time. In this method large vats of paint are provided and the brushes are dipped either one at a time or in groups arranged on racks. Where the

brushes are hung on racks, a small hook is usually driven into the back. Driving the hooks could be done seated so that the loss of one or both legs, heart trouble, hernia, certain nervous disorders, or defective hearing would not prove serious handicaps. The wages are about \$12 a week.

Hand dipping, as has been stated, is usually done by women. When the brushes are dipped in quantities they are hung on a rack which is lowered into the paint by some automatic arrangement. This work is usually done by men. The operator should be active so that loss of two or three fingers, hernia, or defective hearing are the only handicaps which would not interfere with this work. The constant odors of paint or lacquer would prevent any one from doing this work who is ordinarily affected by them. One or two months' experience would offer sufficient training. Wages are about \$20 a week.

Spraying. Spraying is becoming a more popular method for applying paint. The paint or lacquer is contained in a can holding between a pint and a quart of the liquid. By introducing compressed air into the can a fine spray is blown over the handle. This work is usually done seated, the operator holding the brush back in one hand and the spraying device in the other. Frequently some method of carrying off fumes is employed, but even under these conditions there is a marked odor in the room where the work is done. The work involves the same general physical requirements as are needed for dipping, and the wages and training are about the same.

Sanding and Polishing. The finer finishes on toilet brushes are obtained by rubbing the paint or lacquer after it has dried. This work usually involves two or three operations which vary only in that the surface is rubbed with different finishing materials. The first operation is usually rubbing with a very fine sand paper. This is followed by rubbing with a polishing dust, such as pumice.

In a third operation a polishing oil may be applied. All these processes permit the same physical disabilities. The worker may remain seated throughout the day, so that loss of legs would not prove a serious handicap. The loss of one or two fingers, heart trouble, hernia, or defective hearing would also not seriously interfere with the work. Hands and arms must be in constant use, and a moderate amount of muscular strain must be maintained constantly. One or two months' experience, at least, is necessary, and in the case of finer finishing, a longer period is desirable. Wages vary from \$17 to \$20 a week.

Cutting Aluminum Plate for Bristles. The common method for making toilet brushes in this country is to set the bristles in cement. The bristles are usually set in a convex metal plate into the back of which the cement is poured. Aluminum is a very desirable form of metal to be used, as it will not rust or corrode. The aluminum is stamped out in a press machine and at the same time drilled with holes for receiving the bristles. This work can be done seated, provided material is carried to and from the machine. The operator requires the use of both hands, though the loss of two or three fingers would not prove a serious handicap. He should be particularly free from any nervous disorders, as there is an element of risk in the work. The operator might lose his fingers or a hand if his movements were not accurately coördinated. The work could be learned in a few weeks. Wages range from \$20 to \$25 a week.

Putting Bristles into Metal Plates. The most economical method for putting bristles into toilet brushes is a mechanical one. The bristles are put in a hopper at the top of the setting machine. Through a screen in this hopper they are shaken down on a die which holds a perforated plate. Perforations in the die correspond accurately to those in the plate or block, but they are tapered so that

the larger end is at the top. By constantly agitating the hopper the bristles are gradually shaken into the holes in the die. Those that are not caught by the die fall to a pan at the bottom of the machine, and are automatically carried back to the hopper. When all the perforations in the metal plate have been filled it is sent to the cementing room. Operators of these machines are commonly women. The worker must be fairly active with both hands and legs, though there is no very heavy lifting. It is possible that a man who had lost a leg below the knee could engage satisfactorily in this operation. Loss of two or three fingers, hernia, or defective hearing would also not prove serious handicaps. The work could be learned in two or three weeks. Wages usually range from \$18 to \$25 on a piece basis.

Cementing Bristles. After the bristles have been set in place, cement is poured over the back of the metal plate filling in the concave portion of the plate. The work of cementing involves a number of minor operations which seem to be done best by delegating each to an operator and arranging the group on a team-work basis. The various operations are:

1. Inspecting and pounding in bristles.
2. Burning bristle ends to give them greater adhering qualities.
3. Clamping molds.
4. Pouring cement.
5. Taking off molds.
6. Grinding rough edges of cement after pouring.

Most of this work is fairly heavy and demands constant activity. It is possible that inspecting and grinding of cement could be done by a man who had lost a leg. In the other operations the worker should be able-bodied with the possible exception of the loss of one or two fingers, hernia, or defective hearing. All the operations in the

cementing department can be learned in a comparatively short time, though several weeks' experience would be necessary before the operator could acquire a maximum of efficiency. Wages are about \$25 a week.

Assembling Toilet Brushes. Where the back and bristle surfaces are made separately, it is necessary to assemble the two parts of the toilet brushes. This work is commonly done by girls who are seated at their work at tables. The work consists of fastening the brush together with cement. The work is light, and it could easily be done by a man who had lost a leg, providing the material was carried to and from his bench. Loss of two or three fingers, heart trouble, hernia, certain nervous disorders, stiffness of trunk muscles, and also defective hearing would not prevent one from engaging in this operation. The work could be learned in two or three weeks. The wages vary from \$12 to \$14 a week.

TOOTH-BRUSH MANUFACTURE

In general this report will follow a particular method of toothbrush making characteristic of work done in this country. Other methods will vary in detail from this, though involving very similar operations as far as handicapped workers are concerned.

Molding Tooth-brush Handles. Tooth-brush manufacturers in this country commonly use pyroxylin plastics for making handles. This form of handle permits of molding to special shapes by simple processes. The handles are generally prepared in the form of blanks which are simply rectangular sticks of pyroxylin plastic. These blanks are placed in iron molds and heated under pressure. This forms the blank into the shape desired for the tooth-brush handle. The molds employed usually contain a half dozen cavities. The worker heats his blank on a plate before putting it into the mold. The mold is then placed be-

tween the plates of the press where it is allowed to remain for a short time. This work must be done standing, as the operator is required to move constantly between his work bench and the press. Aside from the lifting of the molds, which are not very heavy, the work is light. There is a certain amount of heat from the press, though this is not at all excessive. It is possible that an active man who had lost a leg below the knee could do this work, provided his artificial leg would permit him to stand constantly. The loss of two or three fingers, hernia, or defective hearing would also not prove serious handicaps. Six or eight weeks' experience would be necessary to acquire a maximum of efficiency. The wages are usually on a piece basis and are about \$22 a week, a single worker turning out about 2,000 handles a day.

Removing Rough Edges from Tooth-brush Handles and Polishing. In connection with the finishing of the tooth-brush handles there are a number of minor operations which vary slightly as to method in different places. Where the handle has been molded in the manner described, there are rough edges along the handle at the point where the two halves of the mold have come together. These rough edges are removed by first scraping the handle with a knife. The final surface is obtained by buffing the edges. The scraping is done by women working at tables, and the requirements for this work are the same as in the case of other light, seated operations where the hands are necessary. The work can be learned in an hour's time, though rapidity in manipulation requires several weeks' experience. The wages vary from \$12 to \$18 on a piece basis. The work of buffing is usually done by men who are seated at their buffing wheels. The operation involves very rapid manipulation with the hands. One workman does as many as a thousand handles a day on a piece work basis. Loss of leg, hernia,

certain trunk disabilities, or defective hearing would not prove serious handicaps. The worker should have the use of all his fingers, as they play a very important part in the operation. Wages are about \$22 a week.

Polishing is similar to grinding, except that a final buffing-wheel is used. The physical requirements and wages are practically the same as those for grinding.

Reaming Holes in Handles. In the case of some tooth-brushes a hole is made at the end of the handle for hanging the tooth-brush. The impression for this hole is molded in the handle, but it is not possible to prevent a film of the material from forming over the hole. This must be drilled out. The work is usually done by girls on a piece basis. As in grinding and polishing processes, rapidity of manipulation is essential. As the work could be done seated the loss of a leg would not prevent one from engaging in this operation. Hernia, certain trunk disabilities, or defective hearing would also not prevent one from doing this work. The wages vary from \$12 to \$16 a week on a piece basis.

Putting Bristles into Tooth-brush Handles. After the handles have been ground and polished, they are ready to have the bristles put in. The most popular method in this country is that of stapling. In some cases the holes for the bristles are bored with a drilling machine, and the bristles are stapled in a stapling machine. The more modern method is to combine the two operations on a single machine. The operation of this machine is similar to the operations of the machines where the boring and stapling are done separately. The latter only will be described. In the drilling and stapling machines a dozen or more tooth-brush backs are placed in clamps on a small endless belt which operates in a vertical plane. Each tooth-brush in turn passes before a drill which bores the holes for the bristles. After these have been made, the handle is moved up to the stapling device. This mech-

anism selects the proper amount of bristle from a small tray at the side of the machine and carries the knot to a point directly opposite the hole to be filled. A small staple is driven into the hole and over the bristles. The bristles are doubled, so that the curved end is at the bottom of the hole and the staple fits firmly over the center of the curve. This machine operates very rapidly, so that although each hole must be filled separately, a tooth-brush is turned out complete in about a minute's time. The chief work of the operator is to place and move the handles and see that the bristles do not clog in the machine. Where serious difficulties arise a mechanic is usually available to adjust the machine. For at least a portion of the time the worker could remain seated, so that the loss of a leg below the knee, loss of one or two fingers, hernia, or defective hearing would not prove serious handicaps. Three or four weeks' time is sufficient to become familiar with the operation. The wages are about \$20 a week, commonly on a piece basis.

Miscellaneous Operations in Finishing. There are a number of minor operations through which the tooth-brush must pass after the bristles have been put into the handle. In many cases the trade name is put on the handle. This may be done by a transfer process, in which a lacquer is put over the printing to prevent it from rubbing off. Where a slight curve is put in the handle it is necessary to heat it slightly and to allow it to cool after having been pressed into the desired form. Where a special shape is desired in the bristles, these are trimmed at a machine containing a series of revolving knives. Before the brushes are packed they are frequently cleaned by a vacuum process. In the process of manufacture both the bristles and the handles usually pass through a number of inspections which are similar to the final inspection. These inspections have not been spoken of

in detail because of their likeness. Where the toothbrushes are packed in individual boxes, this work also offers employment of a simple form. All of the operations described under this section are comparatively simple. Most of the work can be done seated for part or all of the day. The chief requirement is rapid and accurate movements of the hands, and in case of inspection operations, a knowledge of and careful attention to certain definite standards. Women are employed for most of this work, though in the case of trimming and inspection some men are also used. The loss of one leg would not prevent one from engaging in any of these operations, and in most cases a worker who had lost both legs would not be disqualified. The fingers are particularly important, though in some cases the loss of one or two fingers might not be a serious handicap. Where the operation was not carried on with the assistance of mechanical devices, heart trouble would not prevent one from engaging in this operation. Hernia, certain trunk injuries, or defective hearing would not be serious handicaps. The wages vary from \$12 to \$20 a week. The operations for men usually pay a somewhat higher rate.

BRUSH MANUFACTURING FIRMS IN DIFFERENT STATES

CONNECTICUT: Wallingford
Wallace & Sons

ILLINOIS: Chicago
Gerts Lombard & Co., 208 Randolph Street

INDIANA: Indianapolis
Indianapolis Brush & Broom Manufacturing Co.

MARYLAND: Baltimore
Bigelow Brush Co., 116 South Register Street
Rennous Kleinle & Co., 848 Frederick Street

MASSACHUSETTS: Boston
A. & E. Burton & Co., 73 Pearl Street
J. C. Pushee & Sons, Randolph and Harrison Streets
John J. Whiting. J. J. Adams Co., Harrison Avenue

MASSACHUSETTS: Florence
Florence Manufacturing Co.

MISSOURI: St. Louis
Sanitol Chemical Laboratory Co.

NEW JERSEY: Arlington
E. I. DuPont, DeNemours & Co. The Arlington Works

NEW JERSEY: Newark
Rubberset Co., 60 Ferry Street
John L. Whiting, J. J. Adams Co., 122 Greenpoint Avenue

NEW YORK CITY
Bradley & Smith, 251 Pearl Street
Devoe & Raynolds Co., Fulton & Williams Streets
Hanlon & Goodman, 270 Pearl Street
J. M. C. Martins Sons, 116 William Street

NEW YORK: Rochester
Shinolo Co., 8 Jay Street

OHIO: Cleveland
Osborn Mfg. Co., 5401 Hamilton Avenue

OHIO: Wooster
Wooster Brush Co.

PENNSYLVANIA: Pittsburgh
Wolfe Brush Co., 1805 Beaver Avenue

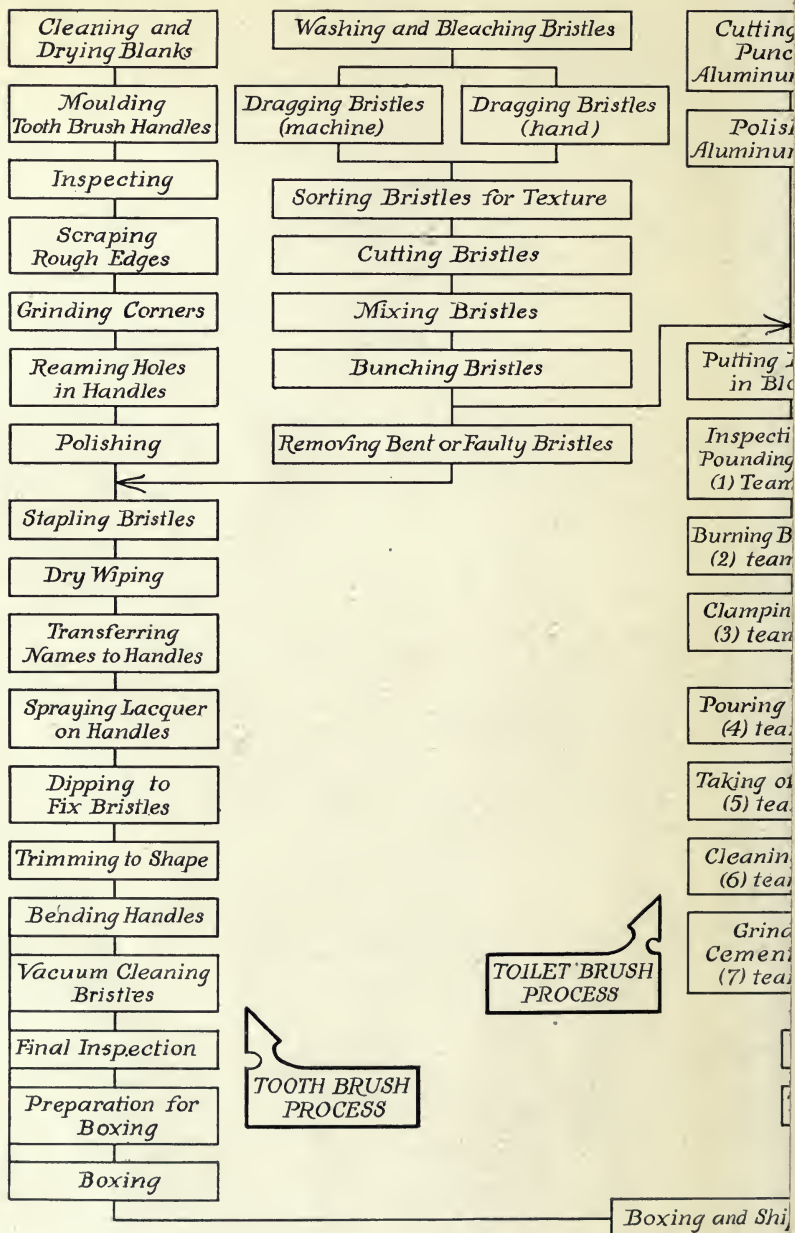
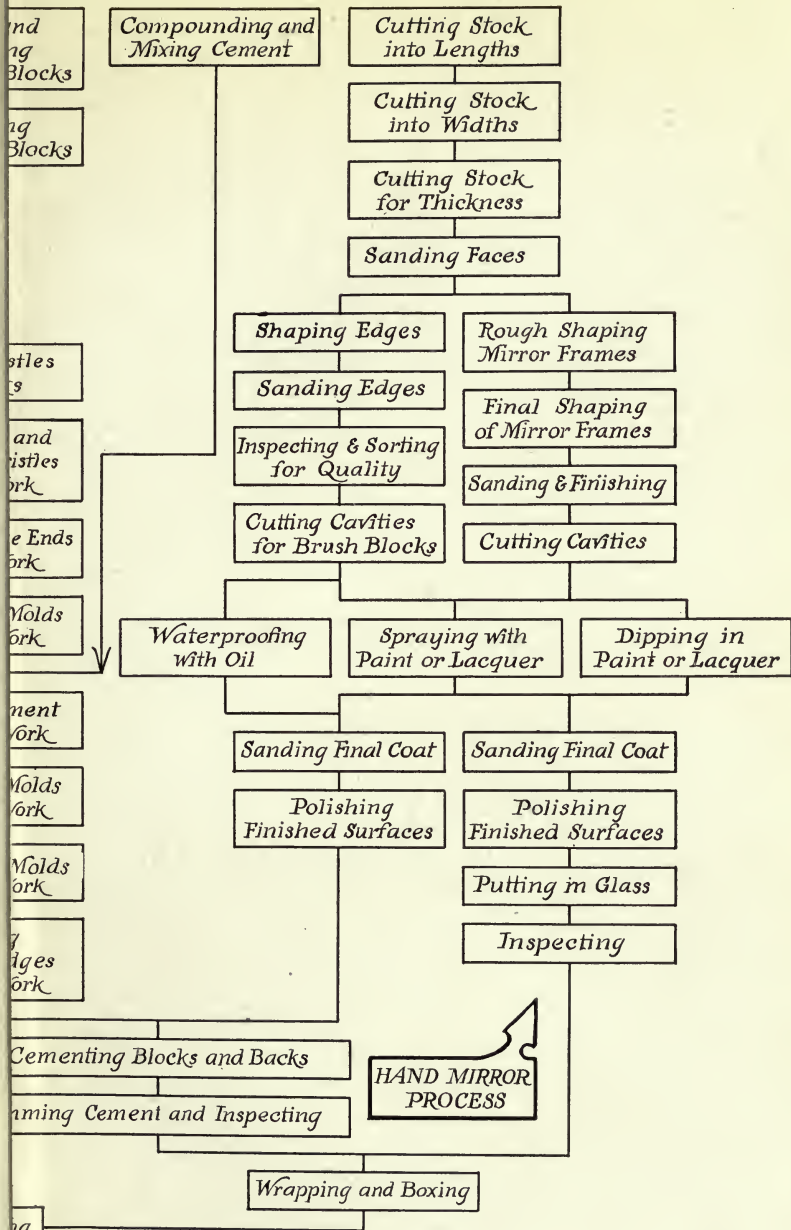


Chart Showing Principal Operations Carried on in a Modern Pla



Manufacturing Tooth Brushes, Toilet Brushes, and Hand Mirrors

Bibliography

Very little has been written in English on the brush industry. Encyclopedia articles are, of course, available. Various census reports supply statistical material. The most valuable of these have been issued by the United States, Canada, Great Britain, France, Germany, and Japan. In 1918, the United States Tariff Commission published a booklet entitled *The Brush Industry*. This booklet contains a brief discussion of the present condition of the brush trade, together with a considerable amount of statistical material relating to the brush industry both in this country and abroad. Below is given a list of some other reference material at present available:

Brooms, Brushes, and Handles. Milwaukee. (Trade Journal.)

Brushmaking. London, England. (Trade Journal.)

Census of Manufacture. Bureau of the Census, Department of Commerce.

Census of Manufactures. Canada.

Census of Production of the United Kingdom, 1907.

Commerce Reports. Bureau of Foreign and Domestic Commerce, Department of Commerce.

Encyclopedia of the Industrial Arts, Manufactures, and Commercial Products.

Leather, Fur, Brushmaking, and Feather Trades. Handbooks on London Trades, Board of Trade, London, 1915.

Report on the British Industry. Bulletin No. 181. The National Child Labor Committee of New York City, 1912.

List of Operations as Related to Disabilities

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Buffing Ferrules	38	Tooth-brush Handles	46
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knee)	28	Shaping Brush Backs (below	
Cutting Cavities in Brushes		knee)	40
(below knee)	41	Soldering Ferrules	35
Cutting Stock for Backs of Toi-		Spraying	42
let Brushes (below knee) . .	39	Stamping Holes (below knee) .	35
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Drawing Bristles	25	Nailing Ferrules to Handles	
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dles	41	Cleaning Brushes	37
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		Round Brushes	30

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Tumbling	35	Drawing Bristles	25
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Reaming Holes in Handles . .	47	Miscellaneous Operations in Finishing	48
Removing Rough Edges from Tooth-brush Handles and Polishing	46	Mixing Bristles	22
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<i>Heart Trouble</i>		Nailing Ferrules to Handles .	36
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Gumming Bristles	29	Putting Bristles into Metal Plates	43
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